Reference 4

FINAL

SITE INVESTIGATION REPORT

INSTA-FOAM PRODUCTS, INC.
CREST HILL, ILLINOIS

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"REALISTIC SOLUTIONS FOR HAZARDOUS WASTE PROBLEMS"

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EXECUTIVE SUMMARY

Remcor, Inc. (Remcor) conducted a hydrogeologic investigation to determine the degree and extent of previously known contamination at Insta-Foam Products, Inc., located in Crest Hill, Illinois. A work plan was prepared and submitted to the Illinois Environmental Protection Agency (IEPA) for review prior to investigation commencement. This investigation was deemed necessary to characterize ground water contamination and the lateral and vertical extent of the contaminants.

Remcor's overall objectives were to delineate waste types currently residing within the quarry pit and identify the possible migration routes of that waste, if they existed. All work was performed in consideration of the most recent U.S. Environmental Protection Agency (EPA) guidance on performance of remedial investigations and with both the Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act of 1986 (CERCLA/SARA) and the National Contingency Plan (NCP).

Subsurface soils within the quarry were found to be contaminated with volatiles and polynuclear aromatic hydrocarbons (PAHs). There appears to be a direct relationship between those samples with elevated levels of total petroleum hydrocarbons (TPHCs) and those with elevated levels of PAHs. Ground water samples within the quarry indicated the presence of volatile organics but no PAHs. Except for monitoring Well 9, all downgradient monitoring wells located outside of the quarry did not indicate contamination similar to that found in the quarry soils. It is believed that the contamination most prevalent within the quarry, PAHs, are a result of the disposal of tank bottoms from refinery processes and that this material still remains as an oil adsorbed to the subsurface soils and as a free product atop the water table.

Based upon the results of the investigation, the following conclusions have been derived:

- Ground water flows to the east at an estimated velocity ranging from approximately 31 to 297 feet per year
- A free-product layer was detected in TSC-3A, TSC-3B, TSC-5, and ERM-3
- Wood debris and roofing material was recovered during the drilling of MW-8 and TB-4. Also, the development water from MW-8 was a dark black color with a burnt wood odor.
- Based upon available information from previous investigations and this investigation, the petroleum contamination seems to be restricted to the western most side of the quarry and is not migrating off site.

1.0 INTRODUCTION

This report presents the results of a site investigation conducted from November 1989 to February 1990 at the Insta-Foam Products, Inc. (Insta-Foam) site located in Crest Hill, Illinois. The report will address the physical and chemical subsurface conditions that were encountered, document the methods used in obtaining data, and present any preliminary recommendations for further assessment. This investigation was conducted by Remcor, Inc. (Remcor) under contract to Flexible Products Company (Flexible Products).

1.1 SITE BACKGROUND AND DESCRIPTION

The Insta-Foam site occupies an area of approximately nine acres in the city of Crest Hill, a northern suburb of Joliet, Illinois. The Insta-Foam property is bordered on the north by a 100-foot right-of-way of the main line of the Elgin, Joliet & Eastern Railway Company, on the east by Broadway Street (U.S. Route 53), on the south by Chaney Avenue, and on the west by a residential housing area. The majority of land use to the north and east is industrialized or agricultural. A site location map is presented in Figure 1.

1.1.1 Operational History

The site was originally a limestone quarry operation. The former quarry pit, which occupied approximately four acres in the center of the property, has been backfilled with a variety of materials, including oily wastes and fire debris. Existing buildings at the site are primarily of wood, stone, and/or metal construction. Aside from Buildings 1 and 2, the existing buildings have been constructed by Insta-Foam since 1979 and are used as offices, warehouses, chemical mixing, storage, and packaging facilities in the manufacture of urethane foam.

The site was operated as a limestone quarry from the late 19th Century until the 1920s. A number of specialty wood products (i.e., cabinetry, sash, and door manufacturers) and lumber milling operations occupied the site until the early 1960s. In the early 1970s, Rovanco, a foam-insulated pipe manufacturer, occupied buildings on the site and operated primarily out of Building 1. Insta-Foam purchased Rovanco's stock in 1972. In 1975, Rovanco was dissolved and the assets transferred to Insta-Foam. As a result of the settlement of a suit for rescission by Rovanco, Insta-Foam separated from Rovanco a few months later. Flexible Products purchased Insta-Foam in 1984. Insta-Foam currently produces urethane foam insulation products at the facility.

1.1.2 Environmental Setting

Materials disposed into the former quarry from the mid-1960s to the mid-1970s are largely unknown. From 1965 to 1970, the facility was not actively used for manufacturing and was, therefore, not closely supervised by the previous owner. Local newspapers reported that Jack Carlstrom of Lockport Trucking Company disposed of tank bottoms from oil storage tanks at a nearby Texaco facility were disposed in the former quarry in the late 1960s. In addition, debris from a 1972 fire at a GAF roofing material manufacturing facility in Crest Hill was reportedly placed in the quarry and appears, based upon visual observation during recent drilling activities, to be located near MW-8 and TB-4. Subsequent to Insta-Foam's assuming total operation of the facility from Rovanco in the mid-1970s, debris from local roadway and parking lot construction were added to the quarry.

1.1.3 Site Physiography and Drainage

Surface elevations across the site range between 580.0 and 595.2 feet above mean sea level (ft-msl). Topography gently slopes to the east towards the Des Plaines River, which is located within one-half mile from the site. Surface elevation at or near the Des Plaines River is 550.0 ft-msl according to the U.S. Geological Survey (USGS), Joliet Quadrangle Topographic Map. The flow of the river is to the south.

The majority of surface drainage from the plant buildings and yard area is across the site (from the southeast to the northwest) where surface water is discharged to a ponded area located at the northwestern extremity of the former quarry pit. The pond is believed to be a remnant of the former quarry.

1.1.4 Regional Geologic Conditions

The bedrock of the Joliet area, including the Insta-Foam site, consists exclusively of Silurian Age Niagarian Dolomite. The bedrock found in the Joliet area, including that encountered during well drilling, consists of limestones (calcium carbonate), dolomite limestones (rocks similar to limestones but containing some magnesium carbonate in place of part of the calcium carbonate), shale (mud rocks), and sandstones. All of these rocks are stratified or bedded and lie more or less horizontally as seen in quarries and rock cliffs. Bedded rocks of this type, where the bedding is more or less parallel for long distances, were deposited in standing water, and from this it is known that the Joliet area was under water. This water was sea water rather than fresh water as demonstrated by the type of fossils found in these rocks (Fisher, 1925).

The upper Niagarian formation, covering most of northeast Illinois, consists of thinly bedded, highly weathered, cherty dolomite of a buff-yellow color, commonly known as limestone. The chert is a fine-grained material composed mostly of silica and occurs either in beds of about two inches thick or, in the case of the Insta-Foam site, in ellipsoidal nodules. Below the chert-rich layers, the dolomite bedrock is more heavily bedded, with beds ranging from 6 to 36 inches thick, compact, even-textured, subcrystalline, bluish-gray, and containing only a small proportion of chert.

The original thickness of the Niagarian Formation is unknown since erosion has removed much of the material from the top of the formation. Deep wells in the Joliet quadrangle penetrate an average thickness of 200 feet of dolomite and limestone before reaching the Richmond Shale.

The geologic materials encountered and examined in the former quarry pit during the subsurface exploration and monitoring well installation included silt, sand and gravel deposits overlying clay, and silty clay units above the dolomite.

1.1.5 Regional Hydrogeology

The shallow bedrock aquifer system is formed by those bedrock units that are recharged locally from precipitation. In northeastern Illinois, this system consists predominantly of Silurian dolomite and shales and dolomites of the Maquoketo Group.

The literature suggests that "there is a good hydraulic connection between Silurian rocks and overlying glacial drift and that the productivity of Silurian rocks is primarily controlled by solution openings in the upper part of the aquifer" (Csallany and Walton, 1963). Dolomites of the shallow bedrock aquifer system yield water primarily from fractures and solution openings rather than from between individual grains as in sand and gravel in a glacial drift aquifer system.

One unconfined aquifer was encountered during both the previous site investigations and Remcor's drilling activities performed at the site. This aquifer occurs in the former quarry pit where silt and clay dominate the geologic regime and in the fractured dolomite bedrock. It is evident that the quarry pit is retarding downward water migration due to the lower permeability of the silts and clays overlying the fractured dolomite bedrock. Hydraulic conductivity (or in-situ permeability) for a glacial till (sand, silt, and clay) ranges from a minimum of 10^{-7} centimeters per second (cm/sec) to a maximum of 10^{-1} cm/sec, while limestone permeabilities range from 10^{-7} to 10^{-4} cm/sec (Freeze and Cherry, 1979). The ground water flow at the Insta-Foam site is in an easterly direction towards the Des Plaines River.

1.2 SUMMARY OF PREVIOUS INVESTIGATIONS

Data are available from previous site investigations performed by ERM, Inc. (ERM) in August 1988 and by Testing Services Corporation (TSC) in November 1988. These investigations were concentrated within the former quarry pit. This previous work included performance of soil borings at 22 locations and construction of 10 monitoring wells in selected borings. Figure 2 shows the existing facility with the locations of each of the wells.

The intent and objectives of ERM's and TSC's investigations were to address the degree of contamination, not the extent of possible off-site migration of contaminants.

The previous data indicated that the quarry was excavated to a depth of approximately 15 to 20 feet below the existing ground surface. All borings within the former quarry encountered debris below the sand/gravel surface. Debris included slag, concrete, wood, and refractory brick. At ERM Wells 2, 3, and 4, oily product accumulations were found on top of the water table. Beyond the limits of the quarry to the north, approximately 2 feet of unconsolidated material was found overlying bedrock at ERM Well 5. In general, ground water was found to be within 10 feet of the existing ground surface in the quarry area.

The previous laboratory analyses performed on ground water and fill samples indicated the presence of organic solvents; polynuclear aromatic hydrocarbons (PAHs); chlorinated aliphatic and aromatic hydrocarbons; and some inorganics. The types of contaminants detected correlated well with the contaminants observed during the current investigation. However, the levels of contaminants as detected from this most recent investigation appear to be generally higher within the quarry soils. Current ground water analyses detected some volatile organic compound (VOC) contamination and no PAH contamination.

Figure 3 is a summary of volatile organic results from previous ground water investigations. Ground water samples indicated the presence of contamination. The chemicals detected included fats, oils, and greases, inorganic chemicals, VOCs, and base-neutral/acid extractable (BNA) compounds. Also, well water levels were noted as changing consistently with the water level in the pond. Analyses of the water in the on-site pond did not indicate the presence of any contaminants.

2.0 SCOPE OF WORK

A focused investigation was necessary to fully characterize existing ground water contamination within the bedrock beneath and surrounding the former quarry area. In addition, the aquifer flow regime required more precise definition with regard to flow direction, rate, and volume. Of primary concern was the potential for public health and/or environmental impact as a result of waste constituent migration from the wastes deposited in the quarry into and through the bedrock via ground water. Therefore, Remcor's objectives included an attempt to delineate waste types currently residing within the quarry and to establish if a hydraulic connection exists between the quarry fill and bedrock. Also, information obtained from this investigation will be used to preliminarily evaluate possible remedial options to mitigate potential adverse impacts from this site, if necessary. This requires the development of exposure scenarios based upon the type and degree of contaminants found.

All work was performed in consideration of the most recent U.S. Environmental Protection Agency (EPA) guidance on performance of remedial investigations and with both the Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act of 1986 (CERCLA/SARA) and the National Contingency Plan (NCP).

2.1 INITIAL ACTIVITIES

Initial activities are summarized as the support work necessary prior to the start of on-site investigations. Initial activities performed for the Insta-Foam investigation were as follows:

- An initial site reconnaissance and meeting with Flexible Products and Insta-Foam personnel
- Collection and evaluation of pertinent existing background data
- Development of a site-specific Health and Safety Plan (HASP)

- Development of a site-specific Quality Assurance Project Plan (QAPP)
- Development of a site-specific Field Sampling and Analysis Plan (FSAP)
- Procurement of drilling and laboratory subcontractors.

An initial site reconnaissance and meeting were held on August 22 and 23, 1989. The site was assessed with regard to local topography, access requirements, potential sampling and well installation points and field activity restrictions. Available data from Insta-Foam records were obtained.

A HASP, QAPP, and FSAP were developed for this site. A HASP was prepared for the purpose of:

- Providing adequate safety protection requirements and procedures for field personnel and subcontractors
- Ensuring adequate training and safety equipment to perform expected tasks
- Providing ongoing task-specific monitoring of health and safety requirements.

This plan contained information such as background data, hazard evaluation, personnel health examinations and emergency procedures.

A QAPP was developed based upon the Remcor Quality Assurance Program and EPA guidance. The plan addressed the following topics:

- Project description
- Project organization
- Data quality objectives
- Analytical and sampling procedures
- Data precision accuracy and completeness
- Quality control checks and requirements
- Standard operating procedures.

The FSAP was written in conjunction with the QAPP and HASP and included procedures for sampling various media that may be encountered. Specific elements of the plan included:

- Types of samples (ground water, soil, etc.)
- Sample numbering
- Duplicates and blanks
- Sampling procedures
- Preservatives
- Decontamination
- Analytical parameters.

2.2 TEST BORING AND SAMPLING

A total of three test borings were advanced in order to estimate waste deposition, the vertical extent of contamination and to identify the fill material in the quarry pit. Figure 2 shows the locations of the test borings.

The test borings were advanced to bedrock using a 3-3/4-inch inside diameter hollow-stem rotary auger. The boring depths ranged from 13.5 feet at TB-3 to 21.5 feet at TB-2 and TB-4. Subsurface soil samples were collected using split-spoon sampling techniques. The samples were immediately sealed in glass containers and logged using the Unified Soil Classification System (USCS). Geological test boring logs detailing soil conditions and observations by Remcor's hydrogeologist during the drilling program are provided in Appendix A.

Containerized soil samples were screened using an HNu™ organic vapor meter (OVM). Headspace readings were taken to determine the presence of VOCs.

Based on headspace field screening, visual observation, and lithology, one soil sample from each boring was selected and forwarded to Weston/Gulf Coast Laboratories, Inc. (Weston) at University Park, Illinois for a chemical analysis by gas chromatography/mass spectrophotometry. Split-spoon recovery quantities from TB-3 were extremely low and subsurface soil conditions consisted primarily of weathered dolomite rock fragments. Therefore, no soil samples from TB-3 were submitted.

2.3 MONITORING WELL DRILLING AND INSTALLATION

A total of five downgradient monitoring wells (MW-2, MW-4, MW-5, MW-9, and MW-10) were installed into bedrock along the north and east perimeters of the Insta-Foam site to provide monitoring capabilities for chemical characterization of the ground water. All of these wells are located outside of the former quarry pit. One monitoring well (MW-1) was installed into bedrock upgradient (southwest) of the site to monitor the upgradient ground water quality. Also, three polyvinyl chloride (PVC) constructed monitoring wells (MW-6, MW-7, and MW-8) were installed directly into the former quarry area to provide additional information concerning soil conditions and ground water quality. Overburden drilling and well installation was performed by Fox Drilling Company of Itasca, Illinois using a CME 75 drill rig.

Three of the six bedrock monitoring wells (MW-1, MW-2, and MW-10) were advanced by NX rock coring to define rock fracture characteristics. Rock coring logs can be found in Appendix A. At the completion of coring activities at each borehole, the borehole was reamed with a 5-/8-inch diameter bit to the desired depth.

Each of the wells has been constructed to monitor the first continuous water-bearing zone that was encountered at each location. The PVC well construction method was used when the first water-bearing zone occurred either within the unconsolidated materials or incompetent bedrock, as in the cases of MW-1, MW-2, MW-6, and MW-7. MW-8 was built with stainless steel well construction materials. The open borehole wells were utilized when the uppermost continuous zone occurred within competent bedrock (MW-4, MW-5, MW-9, and MW-10). The well construction diagrams are shown in Appendix B.

Soil samples were collected in 2.5-foot increments (unless otherwise directed by the on-site hydrogeologist) using split-spoon sampling techniques until the top of bedrock was encountered. The samples were immediately sealed in glass containers and logged according to the USCS method. Soil samples collected were screened using an HNu™ OVM to qualitatively determine the potential presence of VOCs. Based on the HNu™ screen and lithology, selected samples were forwarded to Weston for full chemical analysis.

Eight of the nine monitoring wells were developed by purging the well/borehole with a 1/3-horsepower (HP) submersible pump equipped with a discharge hose and tension line. MW-8 was developed by purging the well with a hand bailer due to the well size. To create enough turbulence within the well to free sediments, the pump was periodically raised and lowered manually. Well development continued until the discharge water from the borehole reached a stable pH, specific conductance, and visual clarity.

An Illinois registered surveyor (Reiter and Associates of Joliet, Illinois) was retained by Remcor to survey the top of casing, ground elevation, and horizontal position of each existing and newly installed well.

Depth to water table surface measurements were obtained using an electrical water level meter. Using these measurements and corresponding casing elevations, a ground water gradient map was constructed for the uppermost continuous water-bearing zone.

2.4 GROUND WATER SAMPLING AND ANALYSES

Ground water sampling was conducted one week after the wells were developed. In addition to the newly installed monitoring wells, three of the existing wells (ERM-2, ERM-3, and ERM-4) from a previous investigation were sampled to confirm previous analyses and as a check on increasing or decreasing trends in the levels of contamination. Prior to sampling, the wells were purged of at least three well volumes and until stable pH and specific conductance values were obtained. Where the well did not yield water at a rate sufficient to evacuate three well volumes with continuous pumping/bailing, the well was pumped/bailed dry and allowed to fully recover before sampling. Well purging was conducted using a submersible pump or by manually bailing.

Monitoring well samples were collected with a decontaminated dedicated stainless steel bailer attached to dedicated polypropylene rope. The first bail of water removed from the well was discarded to rinse the bailer with the sample medium prior to obtaining the sample. The volatile sample fraction was collected first, followed by the remaining sample parameters.

Samples collected from the monitoring wells were analyzed for the following set of parameters:

- Total petroleum hydrocarbons (TPHC)
- Priority pollutant list (PPL) VOCs
- Priority pollutant list - base-neutral/acid extractables
- Full target compound list (TCL) (MW-5, MW-9, and MW-10).

The TCL analyses were performed in accordance with Contract Laboratory Program (CLP) protocol to provide results that would meet Level IV data quality criteria sufficient for risk analyses.

2.5 AQUIFER TESTING

Two aquifer pumping tests were performed at the Insta-Foam site. The first pumping test (bedrock aquifer) was conducted from January 16 to 18, 1990. Over 5,760 gallons of water were continually pumped from MW-2 during this period. The water pumped from the well was contained in a reservoir (aboveground swimming pool) that had a maximum capacity of approximately 18,000 gallons. The containment of the ground water was necessary to prevent aquifer recharge during the pumping test, which would have interfered with drawdown data obtained from the pumping well and nearby monitoring/observation wells.

Water was withdrawn from the pumping well using a 1/3-HP submersible pump. An in-line flow meter and gate valve assembly were installed to measure discharge rates during pumping. This meter was calibrated to actual discharge using a stopwatch. The gate valve assembly was placed ahead of the flow meter to regulate the discharge rate.

Monitoring Well MW-2 was pumped at a constant rate of 2.0 gallons per minute (gpm) for a 48-hour time period. This rate was obtained by performing step-drawdown tests prior to beginning the pump test and was designed to create maximum achievable drawdown in the well and to stress the aquifer so that its pumping limits could be defined. Water-level measurements in surrounding wells were taken with electric water-level indicators. MW-2 and ERM-5 were continually monitored using a pressure transducer data-logger, while MW-7 and MW-9 were monitored using Stevens Type F water-level recorders.

A second pumping test was attempted utilizing ERM-2, located within the quarry fill, as the pumping well. The purpose of this test was to determine if ground water recovery techniques might be a feasible alternative for reducing contamination in the aquifer. Ground water was pumped from ERM-2 with an aboveground 1/2-HP centrifugal pump. An in-line flow meter and gate valve assembly was installed to measure discharge rates. Ground water was discharged to the aboveground swimming pool located to the north of ERM-2.

The well was pumped at a constant rate of 1.0 gpm intermittently for a time span of 4 hours. Due to head loss in the pumping assembly, no usable data were obtained from this test.

Slug tests or rising-head permeability tests were performed on the following monitoring wells: ERM-2, TSC-6, MW-1, MW-7, MW-9, and MW-10. These tests were performed to determine the permeability (hydraulic conductivity) of the water-bearing zone in the immediate vicinity of the well. These tests were initiated by measuring the static water level in the monitoring well. A slug of a known volume was completely submerged and remained until the affected water level reached equilibrium. Once the water level stabilized, the slug was instantaneously removed and water level readings were collected at fixed time intervals until the well fully recovered. These data were then used to calculate the in-situ hydraulic conductivity values at each well location.

3.0 RESULTS OF INVESTIGATION

The results obtained from the site investigation tasks (i.e., drilling activities, ground water sampling, in-situ permeability tests, etc.) are presented and discussed in the following sections.

3.1 GEOLOGIC CONDITIONS

The soil and sediments observed during the drilling program in the former quarry revealed varying soil conditions associated with the typical backfill material (with the exception of varying amounts of wood and felt paper). The boring logs indicate varying proportions of clay, silt, sand, and gravel depending on the area of the quarry in which the drilling operation was taking place.

The depth to bedrock varies with location within the former quarry. This is more than likely due to the excavation practice of the quarry operation during the late 19th Century. Geologic cross sections have been prepared, and the locations of the section lines are shown in Figure 4. Figures 5, 6, and 7 are cross sections that graphically depict the varying subsurface conditions encountered at the Insta-Foam site.

The fill material, or top layer, encountered in the quarry at MW-6 and MW-7 consists of a stiff, brown to tan, clayey silt with varying amounts of fine to coarse limestone rock fragments (gravel). In general, as the boreholes increased in depth, varying amounts of silt and sand were encountered, with the percentage of gravel increasing (Appendix A, Test Boring and Rock Coring Logs).

During the drilling operations at MW-8 and TB-4, wood and felt paper were recovered in the sampling effort. This is believed to be the fire debris that was disposed during GAF's warehouse fire during the early 1970s. It is noted that the ground water observed during development activities at MW-8 displayed a dark black color and exhibited a burnt wood odor.

The bedrock encountered at the Insta-Foam facility consisted of a buff-yellow colored, cherty dolomite. The top portion of this native dolomite is visible along the westerly edge of the former quarry pit. According to the coring data (MW-1, MW-2, and MW-10), the dolomite is slightly weathered, highly fractured with clay filling, massive, and very fine grained. With increasing depth, the dolomite bedrock was found to be more massive with less fracturing occurring. Appendix A presents the coring logs for the aforementioned borings.

3.2 REGIONAL AQUIFER CHARACTERISTICS

The Insta-Foam site is underlain directly by one major water-bearing geologic formation known as the Niagarian Formation of Silurian Age. The Niagarian Formation is characterized by cherty dolomite of a buff-yellow color, thin-bedded, and highly weathered. The chert is a fine-grained material composed mostly of silica occurring in ellipsoidal nodules. Below the chert-rich layers, the dolomite bedrock is more massive, heavily bedded, compact, and contains a small proportion of chert.

3.2.1 Regional Ground Water Occurrence

Ground water occurrence at the Crest Hill facility is primarily within the dolomite bedrock, where flow occurs along fractures, bedding planes, and solution channels. This shallow bedrock aquifer is locally recharged from annual precipitation. The average annual rainfall in northeast Illinois is approximately 36 inches, with precipitation and/or aquifer recharge being the greatest during the months of late spring and early summer (National Water Summary 1985, 1986). Local and regional recharge to the aquifer beneath the Insta-Foam facility occurs from the infiltration of annual precipitation primarily from the higher surface elevations located to the west of the site (Figure 1).

The primary regional discharge area is expected to be the Des Plaines River, which is located east of the site.

The depth to the water table in carbonate rocks is controlled by local site-specific factors such as permeability and topography and by the regional climate. Permeability and topography are developed according to the degree of preferential circulation of subsurface water and the solution of the host rock.

3.2.2 Ground Water Flow Direction

Determined from the installation of monitoring wells from this and previous investigations, the direction of ground water flow was found to be towards the east with some radial flow occurring upgradient on the west side of the site (Figure 8). This ground water contour map was constructed from water-level measurements collected in early January 1990 (Table 4).

The uneven distribution of permeability in the former quarry fill and dolomite bedrock should be considered in evaluating the water table configuration. Local mounds on the water table may indicate areas of recharge greater than that of the surrounding area, or they may indicate recharge areas of lower permeability than that in the surrounding areas. Due to the difference in permeability between the quarry and native dolomite bedrock, water tends to mound in the quarry pit. Analytical data obtained from ground water collected downgradient of the quarry indicates that contamination is not occurring downgradient of the quarry.

3.2.3 Ground Water Velocity

Ground water velocity (or "seepage velocity") estimates were calculated between various points within the former quarry pit area and surrounding bedrock. The following ground water seepage velocity formula was used to perform the calculations:

$$V_s = \frac{K\ I}{n}$$

where:

V_s = seepage velocity, in feet per day (ft/day)

K = hydraulic conductivity, in ft/day

I = hydraulic gradient, in feet per foot (ft/ft)
n = effective porosity, dimensionless.

The hydraulic gradients (I) were obtained by dividing the actual field water level elevation differences of two wells by the distance between the wells, as determined from the site survey.

The calculated horizontal hydraulic gradient of the former quarry pit ranged between 0.007 ft/ft (ERM-2 and MW-8) to 0.033 ft/ft from TSC-6 to MW-8. For the sake of accuracy (or closest approximation), an average value of 0.023 ft/ft was used for the ground water seepage calculation.

The bedrock aquifer horizontal hydraulic gradient displayed values that ranged from 0.015 ft/ft at MW-1 and MW-4 to 0.020 ft/ft at MW-9 and MW-10. An average hydraulic gradient value of 0.017 ft/ft was used for ground water seepage calculations. Table 2 displays calculated horizontal gradients across the site.

In fractured dolomite/limestone, successful and unsuccessful wells can exist in relative close proximity, depending on the number and frequency of water-bearing zones encountered in the borehole. This is true when observing the specific yield capacity of the monitoring wells at the Insta-Foam facility. During development and purging activities performed at the Insta-Foam site, in general, MW-2 showed a relatively moderate yield associated with a fast recovery rate, while the remaining monitoring wells placed in the dolomite bedrock displayed poor to very poor water yields.

Hydraulic conductivity value estimates in the bedrock, as computed from the in-situ slug tests, ranged from 3.7×10^{-4} cm/sec at MW-10 to 7.06×10^{-6} cm/sec at MW-1. The hydraulic conductivity estimates are found in Table 3 and the in-situ tests calculations are found in Appendix D. These calculated values are considered typical for an dolomite/limestone aquifer.

Estimated hydraulic conductivity values for the former quarry pit, as computed from in-situ slug tests are also presented in Table 3. These calculated values ranged from 1.11×10^{-3} cm/sec at TSC-6 to 3.41×10^{-4} cm/sec at ERM-2. The test calculations and data are found in Appendix D.

Hydraulic conductivity (K) values for fractured limestone generally ranged between the magnitudes of 10^{-3} to 10^{-7} cm/sec (Freeze and Cherry, 1979). Reported porosity values for limestones and dolomites range from less than 5 to 50 percent (Fetter, 1980) depending on the number of water-bearing fractures, joints, and bedding planes present in the stratigraphic formation(s). The effective porosity values (n) will be less than the total porosities.

Based on the slug tests performed on a selected number of monitoring wells in the native dolomite bedrock, an average hydraulic conductivity of 2.64×10^{-4} cm/sec was determined. Effective porosity was estimated to ranged from 5 to 25 percent; an average value of 15 percent was used for the ground water seepage velocity:

- $V_s = \frac{K\ I}{n}$ (convert 2.64×10^{-4} cm/sec to 8.66×10^{-6} ft/sec*)
- $V_s = \frac{(8.66 \times 10^{-6}\ \text{ft/sec})\ (0.017\ \text{ft/ft})}{0.15}$
- $V_s = 9.82 \times 10^{-7}$ ft/sec or 8.48×10^{-2} ft/day (30 ft/yr**).

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* - "ft/sec" indicates feet per second.

** - "ft/yr" indicates feet per year.

Ground water seepage velocity for the former quarry fill was calculated using an average hydraulic conductivity of 3.76×10^{-3} cm/sec, an average hydraulic gradient of 0.023 ft/ft and an estimated effective porosity of 30 percent. The calculation is as follows:

- $V_s = \frac{K\ I}{n}$ (convert 3.76×10^{-3} cm/sec to 1.23×10^{-4} ft/sec)

- $V_s = \frac{(1.52 \times 10^{-4} \text{ ft/sec})\ (0.023 \text{ ft/ft})}{0.30}$

- $V_s = 9.43 \times 10^{-6}$ ft/sec or 8.15×10^{1} ft/day (297 ft/yr).

3.3 SOIL ANALYSES

A total of five soil samples were collected at the Insta-Foam site during the field investigation. The soil samples were collected from the following locations within the quarry:

- MW-8 (13.5- to 15.5-foot depth)
- TB-2 (composite from various depths)
- TB-4 (15.5- to 17.5-foot depth)
- MW-7 (composite from various depths)
- MW-7 (center plug).

No soil samples were analyzed from the perimeter well borings due to the relative proximity of the fill/bedrock interface to ground level and the absence of volatile compounds in field screening of these soils. In addition, no soil sample was analyzed from MW-6 because the geologic strata consisted mostly of clean dolomite rock fragments, thus providing extremely low sample recovery.

The selection of soil samples sent for laboratory analyses was based on visual observation and field screening results. The soil samples submitted to the laboratory were analyzed for the following parameters:

- Total petroleum hydrocarbons
- Priority pollutant list - volatile organic compounds
- Priority pollutant list - base/neutral acid extractables.

Elevated concentrations of TPHC were found in various locations within the quarry. The highest TPHC level was found in MW-8 with a concentration of 103,000 milligrams per kilogram (mg/kg), or approximately 10 percent TPHCs by weight. Other locations with elevated levels included both soil samples from MW-7 with values of 1,090 mg/kg and 978 mg/kg, TB-2 had a concentration of 422 mg/kg, and TB-4 with a level of 109 mg/kg. Elevated concentrations of the VOCs detected in the soils include: methylene chloride; acetone; benzene, toluene, ethylbenzene, and xylene (BTEX); 1,2-dichloroethane; 1,1,1-trichloroethane; and tetrachloroethene. Table 4 presents the detected compounds observed in the soil samples.

As can be seen from Table 4, the samples from MW-8 contained the highest concentrations of site contaminants, as compared to other soils analyses. Also, the contaminants were observed to exist well within the limits of the former quarry. Elevated concentrations of PAHs were detected at various locations within the quarry. All soil samples contained PAHs at varying levels. Appendix C presents the laboratory data for the soil samples.

3.4 GROUND WATER ANALYSES

Eleven ground water samples were collected from eight of the newly installed wells and three existing monitoring wells. The ground water samples submitted to the laboratory were analyzed for the following parameters:

- Total petroleum hydrocarbons
- Priority pollutant list - volatile organic compounds
- Priority pollutant list - base neutral/acid extractables
  Target compound list (selected samples).

Downgradient perimeter wells selected for full TCL analyses are MW-5, MW-9, and MW-10.

3.4.1 Organics

The maximum level of TPHC in the ground water was observed in ERM-3 with a concentration of 92.2 mg/ℓ. Elevated TPHC concentrations ranged from 4.67 mg/ℓ at MW-2 to 92.2 mg/ℓ at ERM-3. The ground water samples from MW-8, MW-10, ERM-2, and ERM-4 indicated high concentrations of methylene chloride. Methylene chloride concentrations ranged from 20 micrograms per liter (μg/ℓ) in MW-10 to 8,100 μg/ℓ in ERM-2. Trichlorofluoromethane was detected in MW-4, MW-8, and ERM-4 at values of 150, 1,400, and 11 μg/ℓ, respectively. Elevated concentrations of acetone were detected in MW-2 at 32 μg/ℓ and MW-4 at 60 μg/ℓ. Detected organic contaminants are tabulated in Table 5. Figure 9 shows the distribution of contaminants by location.

Despite the high values for contaminants found in the soils obtained from MW-8, analyses of the ground water from MW-8 indicated very low concentrations of the same contaminants. This apparent incongruity possibly suggests that the constituents are immobilized due to the adsorption capacity of the soils or they are somewhat restricted to the oily phase. The analytical results for ground water samples can be viewed in Appendix C.

3.4.2 Inorganics

A selected group of downgradient monitoring wells were utilized for TCL compound analyses, including inorganics. Samples from these wells (MW-5, MW-9, and MW-10) were analyzed to better define ground water quality conditions near the perimeter of the Insta-Foam site and to determine if contamination was migrating off site.

Calcium, magnesium, sodium, and zinc were detected in all three monitoring wells at varying levels. Concentrations of calcium ranged from 115 μg/ℓ at MW-5 to 223 μg/ℓ at MW-10. Magnesium concentrations ranged from 48.9 μg/ℓ at MW-9 to 113 μg/ℓ at MW-10. Calcium and magnesium are probably a result of the dissolution of the dolomite bedrock. Other inorganics consistently detected include sodium and zinc; sodium ranged from 17.9 μg/ℓ at MW-5 to 23.4 μg/ℓ at MW-9 and zinc ranged from 0.027 μg/ℓ at MW-10 to 1.4 μg/ℓ at MW-5.

Detected inorganic compounds are presented in Table 6. Figure 10 indicates the distribution of inorganic compounds in the ground water.

3.5 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) SAMPLE ANALYSES

As a measure of analytical precision and as a check on the effectiveness of the equipment decontamination procedures, one replicate sample and one field rinsate blank were collected.

The field rinsate blank (bailer) was analyzed for TPHC, PPL VOCs, and BNAs. The analytical results revealed no elevated concentrations of the aforementioned parameters.

The replicate water sample collected from ERM-3 showed consistent concentrations as compared to the original sample. The analytical results of the QA/QC samples are found in Appendix C.

During the preinvestigation planning and development, it was expected that sufficient amounts of overburden soil would be obtainable from the perimeter drilling activities. Remcor expected to obtain a replicate soil sample from one of the downgradient perimeter wells, but sufficient overburden was not present. No replicate soil sample was obtained.

3.6 ROOFING MATERIAL ANALYSES

Felt-like material was retrieved from the drilling augers during the investigation. Samples of this material were obtained during drilling operations at MW-8 and TB-4. In addition, a sample of similar material was obtained during the previous investigation performed at this site in 1988.

Historical data indicate that roofing material was disposed in the quarry. To determine if the felt-like material contained asbestos, three samples were forwarded to the R.J. Lee Group, Inc., Monroeville, Pennsylvania for analysis.

Analysis of the samples were made using the polarizing light microscope and dispersion staining in accordance with guidelines set forth in the EPA Interim Method for the Determination of Asbestos in Bulk Insulation Samples, 40 Code of Federal Regulations (CFR) 763, Subpart F.

Results from all three samples indicated that asbestos was not present within the samples. Analyses revealed that the materials were composed of varying percentages of cellulose and nonfibrous material.

3.7 FREE-PRODUCT ANALYSES

On February 13, 1990, samples of free-floating product from two of the existing wells (TSC-3A and TSC-3B) were composited and sent for analyses by Weston. This material is described as black and highly viscous with a strong petroleum odor. The sample was analyzed for TCL constituents, which include volatile organics, BNAs, and total lead content. Because the sample contained very high concentrations, it was necessary to highly dilute the sample to quantify the detected compounds. Analyses indicate that very high levels of PAHs are present within this material. Many of the same compounds that were detected at elevated concentrations within the soils were also present at high concentrations within the free product. Complete analytical results of all media are presented in Appendix C.

3.8 EXTENT OF FREE PRODUCT

Phase-separated hydrocarbons (free product) is a term used to describe the waste oil constituents that are less dense than water and appear atop the water table. Figure 11 shows the estimated area or extent of the phase-separated hydrocarbon plume. As noted in the figure, it is estimated based on current data, that the plume extends over an area of about 20,000 square feet (ft^2).

Product thickness measurements ranged between 0.21 foot in ERM-3 to 0.61 foot in TSC-3A. Other wells that contained a layer of product atop the water table include TSC-3B (0.33 foot) and TSC-5 (0.23 foot).

The measured product in the monitoring wells represents the "apparent" thickness, not the "true" thickness of product atop the water table. The difference between true and apparent thickness has been attributed to the capillary fringe. A geological formation containing coarse grains will have large pore spaces that will greatly reduce the height of the capillary fringe. Fine-grained formations will have much smaller pore spaces, thus allowing for a higher capillary height.

Because the phase-separated hydrocarbon occurs above and within the capillary fringe, once the monitoring well penetrates and destroys the capillary fringe, product migrates into the borehole. The ground water that stabilizes in the well will be lower than the surrounding capillary fringe in the formation. Due to the lowering of the free water, hydrocarbons will flow into the well from their elevated position atop the capillary range. This process will continue and depress the water surface until a density equilibrium is established. Therefore, a greater apparent thickness is measured in a well than what is actually present in the formation.

For calculating the total volume of free-floating product at the Insta-Foam facility, an average apparent product thickness of 0.345 foot was used in the equation.

Based on the calculations presented in Appendix E, an estimated 9,000 gallons of free-floating product is present at the Insta-Foam site.

4.0 PROBABLE FATE AND TRANSPORT OF CONTAMINANTS

There are various physical, chemical, and biological processes that can govern the movement and ultimate fate of contaminants in the subsurface environment. At the Insta-Foam site, the localized nature of the contaminants and the absence of downgradient contamination suggest that the contaminants are bound in the fill matrix of the quarry and not migrating from the quarry and subsequently off site.

Under normal conditions of released hydrocarbons to the subsurface environment, significant quantities will first adsorb to the geologic materials. If significant product is lost, which overcomes the adsorptive capacity of the geologic matrix, the excess amount will enter the ground water until the capacity of the ground water to dissolve the hydrocarbon is fulfilled. Once the capacity of the water to dissolve the hydrocarbons is overcome, the likelihood of developing free product atop the water table presents itself. From each of these three phases, the vapor phase can be generated. In reviewing the four phases, or physical states in which the contaminant can manifest itself, the adsorbed state usually accounts for 50 to over 90 percent of the contaminant presence. The phase-separated or free product can account for 0 to 40 percent of the fugitive product. These percentiles are dependent on the soil/geology conditions. The dissolved phase contaminant normally represents approximately 1 to 10 percent of the total contaminant loss to the subsurface environment. As previously noted, all phases can and do contribute to the vapor phase that represents less than 1 percent of the hydrocarbon lost.

For organic constituents associated with petroleum products such as those within the quarry, the important processes that affect the fate of contaminants in soils are volatilization, adsorption/desorption, and biodegradation.

PAHs are usually defined as compounds consisting of carbon and hydrogen in the form of three or more fused aromatic rings. The PAHs that revealed elevated concentrations in soils are shown in Table 4. PAHs are very geochemically stable compounds. PAHs exhibit low volatility and solubility, high adsorption tendency, and moderate biodegradability.

The concentration of individual constituents measured in the oil (waste) phase is typically two to three orders of magnitude greater than in the aqueous phase. This indicates that the compounds have an enhanced solubility in the oil phase and preferentially are attenuated in the oil phase. Therefore, the mobility of these compounds is strongly affected by the mobility of the oil phase in the soil.

Studies conducted by the American Petroleum Institute indicate the concentration of individual constituents of oil (waste) measured in the soil were one to two orders of magnitude greater than the concentration measured in the aqueous phase. This indicates that compounds released from the oil into the soil/water are strongly attenuated in the soil, thereby limiting their mobility due to water transport through the soil column.

Because of their hydrophobic characteristics, as evidenced by low aqueous solubilities, PAHs exhibit a strong tendency to adsorb on soils. Such adsorption appears to play a major role in the lack of ground water transport of detected PAHs at the Insta-Foam site. As a general rule, the adsorption tendency increases with increasing molecular weight. For PAHs containing five or more fused rings, adsorption in organic soils is so strong that the compounds are essentially immobile, and are likely to flow 100 to 1,000 times more slowly than ground water due to the adsorption effects.

5.0 SUMMARY

The site investigation has provided an understanding of the general hydrogeological conditions and the presence of PHC contamination at the Insta-Foam facility. The following findings and conclusions are based on the results of this investigation:

- Based on Remcor's subsurface investigation and evaluation of previous studies, the detected contaminants appear to be relatively immobile due to the adsorption capabilities of the geologic matrix and the nature/composition of the contaminants and are not migrating from the quarry.

- The uppermost continuous water-bearing zone occurs within a fractured dolomite/limestone aquifer. This shallow aquifer is locally recharged from infiltration of precipitation; discharge is expected to be to the Des Plaines River.

- Based on the permeability testing performed, the average hydraulic conductivity for the former quarry pit is 3.76×10^{-3} cm/sec while the dolomite bedrock is 2.64×10^{-4} cm/sec. Based on this limited information, the former quarry pit and dolomite bedrock behave as a single aquifer with some downward leaking from the quarry pit to the bedrock.

- The primary direction of ground water flow is towards the east with some radial flow occurring near the west perimeter of the site. The regional discharge is expected to be the Des Plaines River.

- Based on limited data, the ground water velocity has been estimated to range from approximately 31 to 297 ft/yr.

- A number of soil and ground water samples were analyzed for TPHC, PPL VOCs, BNAs, and TCL parameters (selected few). Positive detections were reported in both media:

  - Elevated concentrations of TPHC in soils were found in various locations including MW-7, MW-8, TB-2, and TB-4. Elevated concentrations of the aromatic compounds were detected across the site. These compounds include methylene chloride, acetone, BTEX, 1,2-dichloroethane, 1,1,1-trichloroethane, and tetrachloroethene. A number of semi-volatile organics were detected in high concentrations in soils.

- Elevated concentrations of TPHC in ground water were detected in Monitoring Wells MW-7, MW-8, ERM-2, ERM-3, and ERM-4. The following VOCs were found in various locations across the site: methylene chloride, acetone, 4-methyl-2-pentanone, BTEX, and trichlorofluoromethane.

- A free-product layer was detected in TSC-3A, TSC-3B, TSC-5, and ERM-3, with an average thickness of 0.345 foot. Based on calculations, an estimate of approximately 9,000 gallons of free product is present at the Insta-Foam site.

- Based on sample recovery effort during the drilling of MW-8 and TB-4, it is concluded that roofing materials have been disposed in the former quarry pit. However, the volume of roofing material is not known.

- During the development and purging activities conducted at MW-8, it was observed that the ground water recovered was a dark black color with no oily sheen or headspace reading but it exhibited a burnt wood odor. It is believed that this water had been in direct contact with the fire debris.

6.0 CLOSING

Remcor trusts that this report satisfies Insta-Foam's need for an assessment of subsurface conditions at the Crest Hill, Illinois facility. The basic hydrogeologic and contaminant characteristics of the site are now understood, enabling Insta-Foam to formulate an appropriate response to the existing conditions that were encountered.

Remcor appreciates the opportunity to have served Insta-Foam on this important project.

Respectfully submitted,

Peter J. Welch
Hydrogeologist

Edward L. Baer
Senior Scientist, Quality Assurance Officer

Deborah T. Marsh
Director - Environmental Compliance

TABLE 1

PROJECT NO:. 89233.4
LOCATION: CREST HILL, IL
DATE: 1-16-89
GEOLOGIST/ENGINEER: PJW
METHOD: ELECTRONIC WATER LEVEL METER

EXISTING MONITORING WELLS
STATIC GROUND WATER LEVEL MEASUREMENTS

WELL ID NO.	TSC-2	TSC-3A	TSC-3B	TSC-5	TSC-6	ERM-1	ERM-2	ERM-3	ERM-4	ERM-5
TOC ELEV(MSL)	586.71	587.66	587.62	586.2	586.42	590.79	588.39	587.57	586.18	585.05
DEPTH TO WATER	10.87	13.8	9.2		11.27	18.55	15.09	10.19	13.47	10.12
DEPTH TO OIL										
OIL THICKNESS		PRODUCT	PRODUCT	PRODUCT				PRODUCT		
PRODUCT GRAVITY										
CORRECTED DEPTH TO WATER										
CORRECTED WATER ELEV(MSL)	575.84	573.86	578.42		575.15	572.24	573.3	577.38	572.71	574.93

TABLE 1 (con't)

PROJECT NO.: 89233.4
LOCATION: CREST HILL, IL
DATE: 1-16-90
GEOLOGIST/ENGINEER: PJW
METHOD: ELECTRONIC WATER LEVEL METER

NEWLY INSTALLED MONITORING WELLS
STATIC GROUND WATER LEVEL MEASUREMENTS

WELL ID NO.	MW-1	MW-2	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10
TOC ELEV(MSL)	598.45	586.59	591.91	590.84	587.76	585.52	583.79	587.36	589.52
DEPTH TO WATER	24.63	13.55	23.25	23.35	18.5	12.78	11.55	14.55	21.71
DEPTH TO OIL									
OIL THICKNESS									
PRODUCT GRAVITY									
CORRECTED DEPTH TO WATER									
CORRECTED WATER ELEV(MSL)	573.82	573.04	568.66	567.49	569.26	572.74	572.24	572.81	567.81

TABLE 2

HORIZONTAL HYDRAULIC GRADIENTS

WELL LOCATIONS	CHANGE IN HEAD (ft)	DISTANCE (ft)	HYDRAULIC GRADIENT (ft/ft) (1)
Bedrock Wells			
MW-10 to MW-9	5.00	256	0.020
MW-1 to MW-5	6.33	368	0.017
MW-1 to MW-4	5.16	335	0.015
Quarry Fill Wells			
TSC-6 to MW-8	2.91	88	0.033
ERM-2 to MW-8	1.06	152	0.007
TSC-6 to ERM-4	2.44	88	0.028

(1) Equation: $I = \frac{H1 - H2}{D}$

Where:

I = Hydraulic Gradient
H1 = Ground Water Elevation of Well 1
H2 = Ground Water Elevation of Well 2
D = Distance Between Well 1 and Well 2

TABLE 3

HYDRAULIC CONDUCTIVITY (K) ESTIMATES

WELL NUMBER	ESTIMATED (K)
MW-10	3.70 x 10-4 cm/sec
MW-1	7.06 x 10-6 cm/sec
MW-9	4.16 x 10-4 cm/sec
MW-7	9.83 x 10-3 cm/sec
TSC-6	1.11 x 10-3 cm/sec
ERM-2	3.41 x 10-4 cm/sec

TABLE 4
LABORATORY ANALYTICAL RESULTS FOR CONTAMINANTS IN SOILS (1)

PARAMETERS	MW-8 13.5'-15.5'	TB-2 Composite	TB-4 15.5-17.5	MW-7 Composite	MW-7 Auger
Petroleum Hydrocarbons	103,000 mg/kg	422 mg/kg	109 mg/kg	1,090 mg/kg	978 mg/kg

VOLATILE ORGANICS	MW-8 ug/kg	TB-2 ug/kg	TB-4 ug/kg	MW-7 ug/kg	MW-7 ug/kg
Methlylene Chloride	110		39	31	73
Acetone	760	230,000B	1,400B	4100	82
Benzene	530		200		
Toluene	140		230		
Ethylbenzene	66		40		
Xylene (Total)	150	2300	110		
1,2 Dicholorethane		110			
1,1,1 Trichloroethane				6	9
Tetrachloroethane				21	87

SEMIVOLATILE ORGANICS	MW-8 ug/kg	TB-2 ug/kg	TB-4 ug/kg	MW-7 ug/kg	MW-7 ug/kg
Naphthalene	43,000		450		1,000
Acenaphthylene					670
Acenaphthene	220,000	800	1,200		6,100
Fluorene		890	1,000	390	2,000
Phenanthrene	1,000,000	6,000	5,100	840	6,100
Anthracene	330,000	1,200	1,200		1,400
Fluoranthene	940,000	3,600	3,500	740	3,800
Pyrene	740,000	5,000	4,000	910	5,900
Benzo (a) Anthracene	390,000	1,700	1,500		1,800
Chrysene	340,000	1,700	1,500		2,000
Benzo (b) Fluoranthene	270,000	1,600	1,600	430	1,700
Benzo (k) Fluoranthene	200,000	1,000	1,100		1,300
Benzo (a) Pyrene	260,000	1,300	1,200	420	1,700
Ideno (1,2,3-cd) Pyrene	240,000	1,200	850		1,200
Dibenzo (a,h) Anthracene	92,000				
Benzo (g,h,i) Perylene	260,000	1,400	980		1,600

(1) Detected compounds only.

"B" Indicates compound found in Blank.

TABLE 5
LABORATORY VOLATILE ORGANIC ANALYTICAL RESULTS
IN GROUND WATER (1)

PARAMETERS	MW-1 mg/l	MW-2 mg/l	MW-4 mg/l	MW-5 mg/l	MW-7 mg/l	MW-8 mg/l	MW-9 mg/l	MW-10 mg/l	ERM-2 mg/l	ERM-3 mg/l	ERM-4 mg/l
Petroleum Hydrocarbons					4.7	24.4			37.9	92.2	11.5

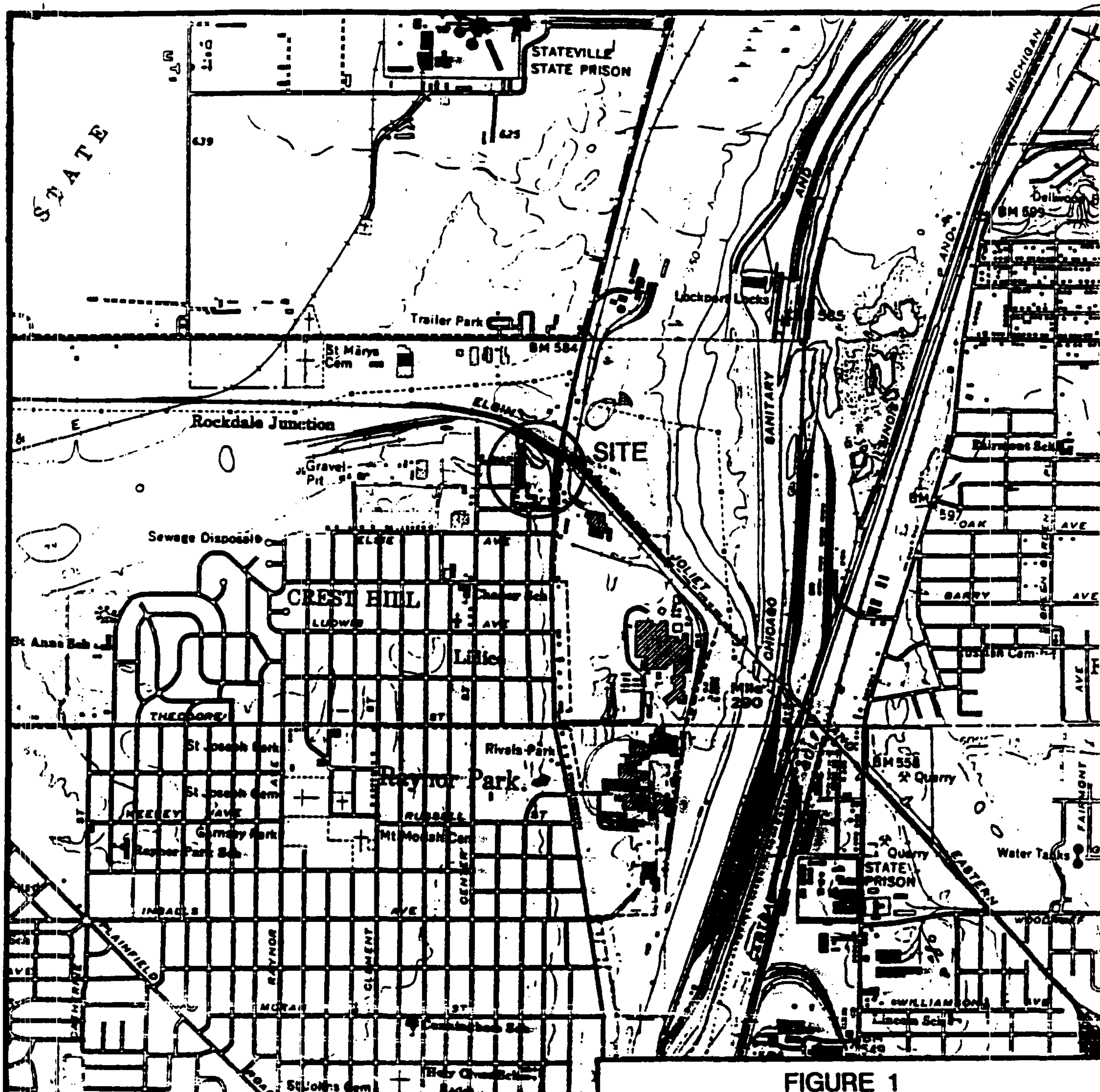
VOLATILE ORGANICS	MW-1 ug/l	MW-2 ug/l	MW-4 ug/l	MW-5 ug/l	MW-7 ug/l	MW-8 ug/l	MW-9 ug/l	MW-10 ug/l	ERM-2 ug/l	ERM-3 ug/l	ERM-4 ug/l
Methlylene Chloride						32		20	8100	1800	
Acetone		32	60								
4-Methyl-2-Pentanone							12				
Benzene							11				
Toluene							13			35	
Ethylbenzene							10			140	
Xylene (Total)							150			510	
Trichlorofluoromethane			150			1400					11

(1) Detected compounds only.

TABLE 6
LABORATORY INORGANIC ANALYTICAL RESULTS
IN GROUND WATER (1)

INORGANICS (TARGET COMPOUND LIST)	MW-5 mg/l	MW-9 mg/l	MW-10 mg/l
ALUMINUM, Total			0.27
CALCIUM, Total	115	113	223
IRON, Total	0.64	1.3	4.2
LEAD, Total		0.0054	
MAGNESIUM, Total	64.8	48.9	113
MANGANESE, Total		0.65	0.37
SODIUM, Total	17.9	23.4	21.2
ZINC, Total	1.4	0.27	0.027

(1) Detected compounds only.



2000 0 2000 4000

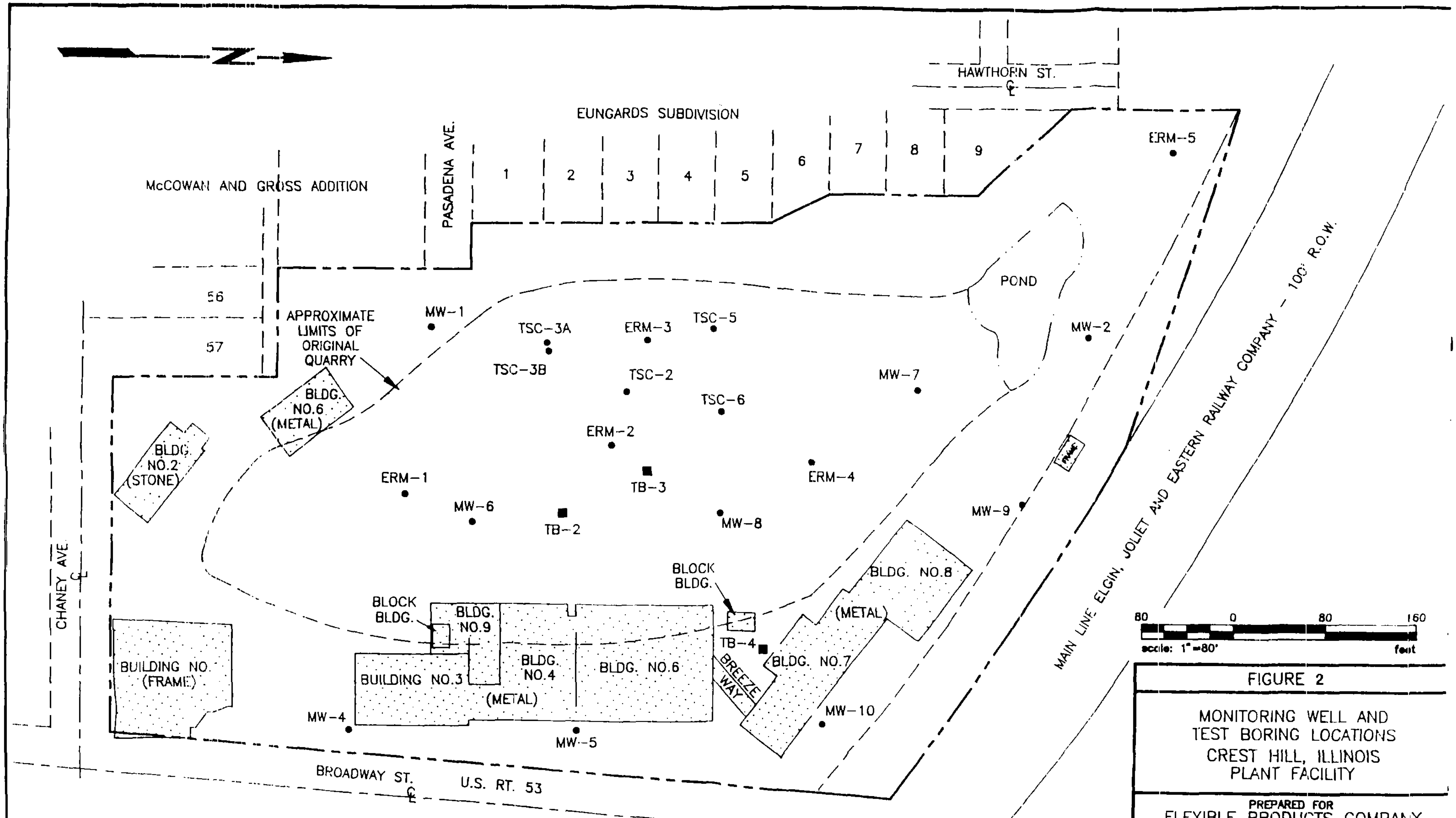
scale feet

N

USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE,
JOLIET, ILL., 1963 PHOTOREVISED 1973
SCALE 1:24,000

FIGURE 1	
SITE LOCATION MAP CREST HILL, ILLINOIS PLANT FACILITY	
PREPARED FOR FLEXIBLE PRODUCTS COMPANY	
DRAWN L.B.L. 2/21/90	DRAWING NUMBER
CHECKED	89233-A6
APPROVED	

REMCOR



LEGEND:

- ● = MONITORING WELL LOCATION
- ■ = APPROXIMATE TEST BORING LOCATION
- — - — = PROPERTY LINE

NOTE:
THIS MAP IS BASED ON SURVEY AND DRAWING MADE BY BEIJNG ENGINEERING CONSULTANTS, JOB No. BLS19845-11 REVISED 5/10/82.

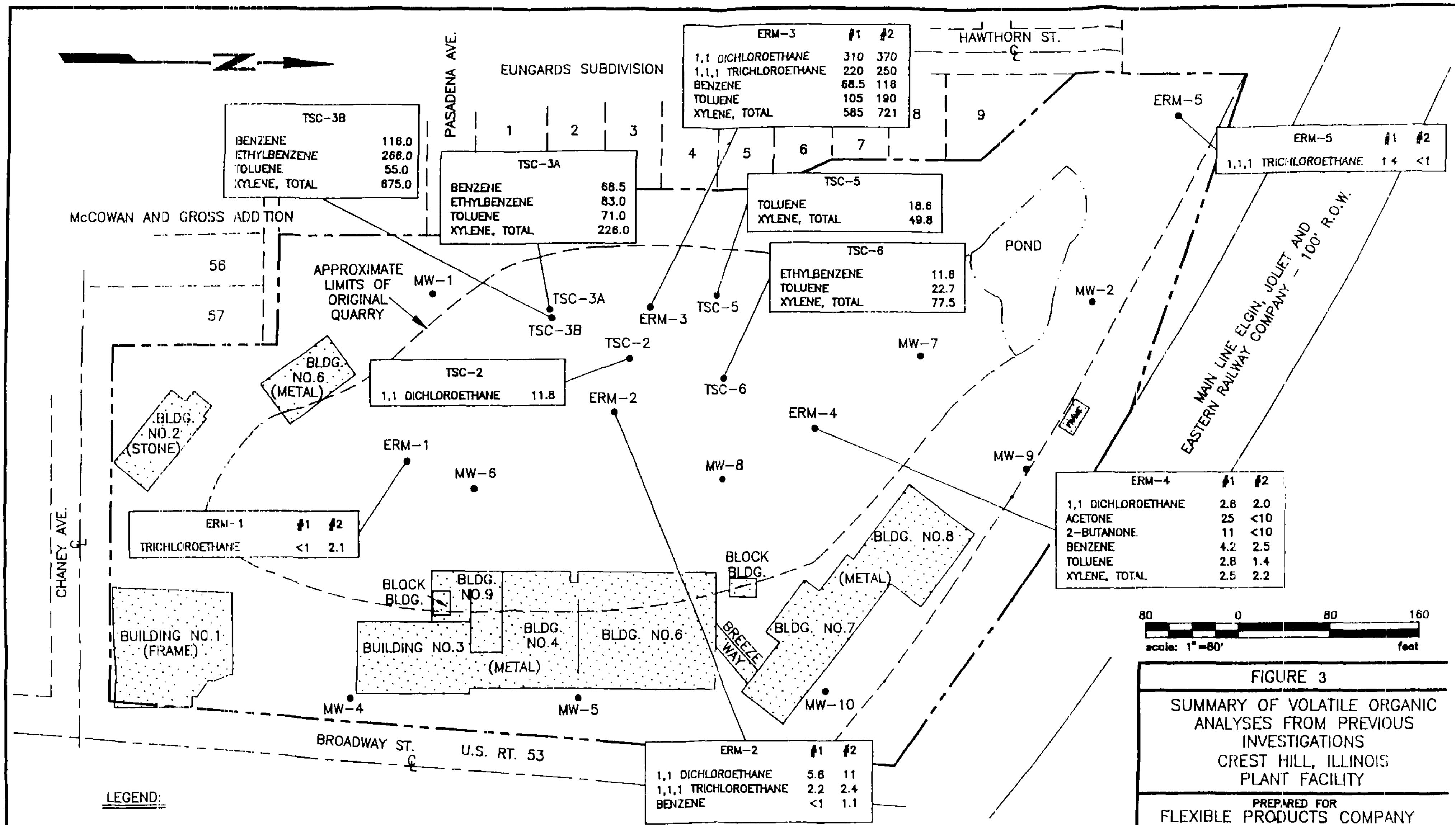
FIGURE 2

MONITORING WELL AND TEST BORING LOCATIONS
CREST HILL, ILLINOIS
PLANT FACILITY

PREPARED FOR
FLEXIBLE PRODUCTS COMPANY

DRAWN	L.B.L. 3/1/90	DRAWING NUMBER 89233-B14
CHECKED		
APPROVED		

REMCOR



LEGEND:

- ● = MONITORING WELL LOCATION
- — - - — = PROPERTY LINE

ERM - JULY, 1988 (2 SAMPLING EVENTS)
TSC - NOVEMBER, 1988

NOTES:
1. THIS MAP IS BASED ON SURVEY AND DRAWING MADE BY BELING ENGINEERING CONSULTANTS, JOB No. BLS19845-11 REVISED 5/10/82.
2. ANALYTICAL RESULTS ARE SHOWN IN ug/l (PPB).

FIGURE 3

SUMMARY OF VOLATILE ORGANIC ANALYSES FROM PREVIOUS INVESTIGATIONS
CREST HILL, ILLINOIS
PLANT FACILITY

PREPARED FOR
FLEXIBLE PRODUCTS COMPANY

DRAWN	L.B.L. 2/14/90	DRAWING NUMBER
CHECKED		89233-B11
APPROVED		

REMCOR

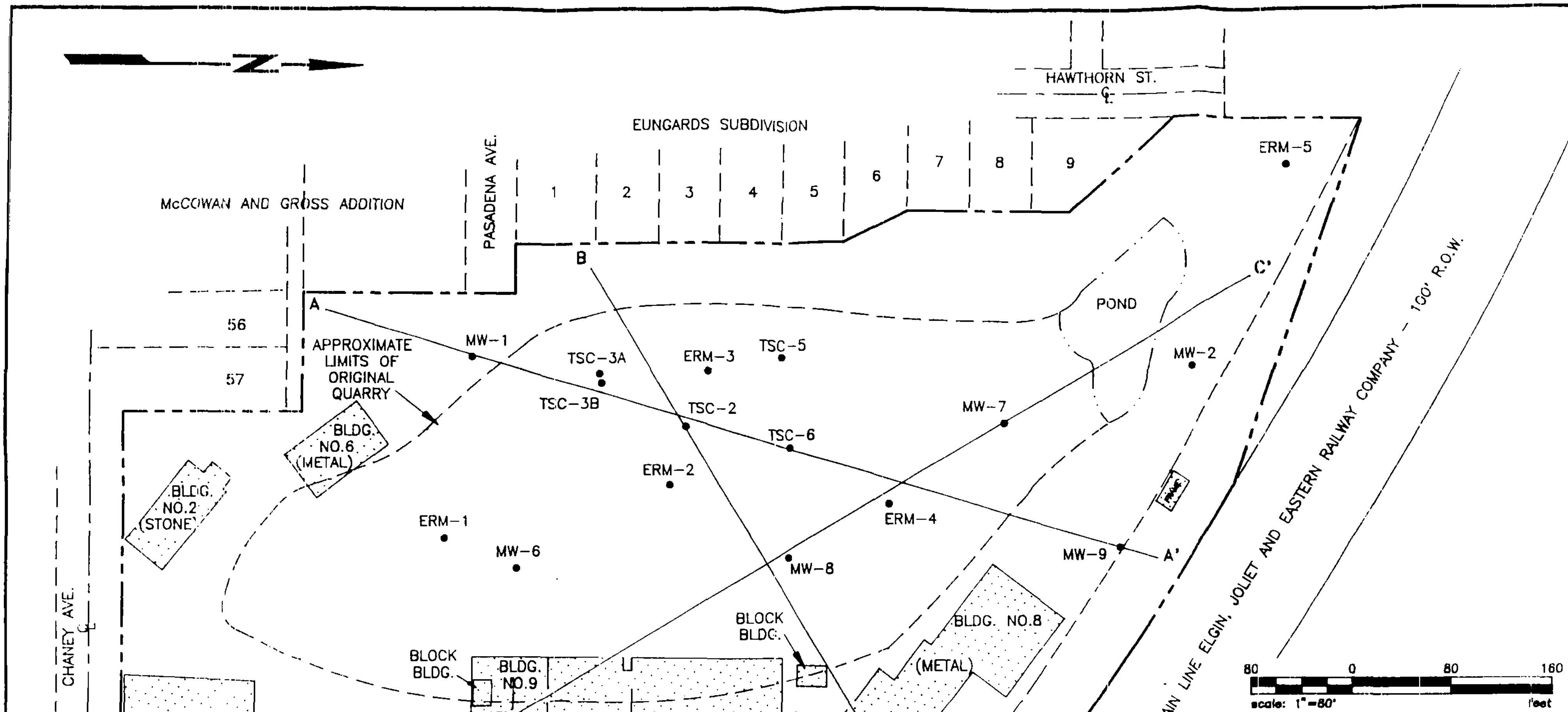


FIGURE 4

GEOLOGIC CROSS SECTION LOCATIONS
CREST HILL, ILLINOIS PLANT FACILITY

PREPARED FOR
FLEXIBLE PRODUCTS COMPANY

DRAWN	1/30/90 L.H.K.	DRAWING NUMBER 89233--B6
CHECKED		
APPROVED		

REMCOR

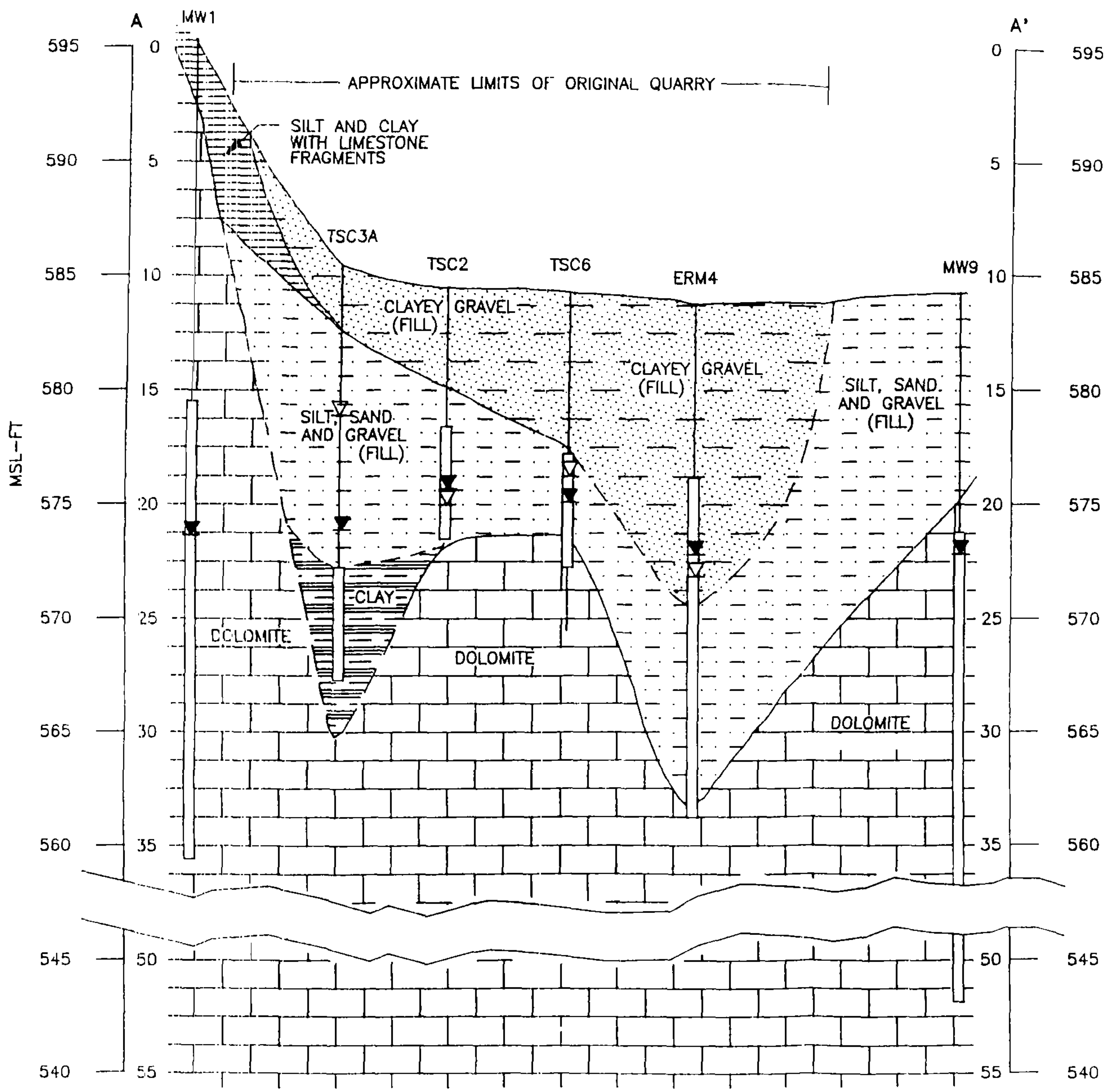
LEGEND:

● = MONITORING WELL LOCATION

= PROPERTY LINE

A ——— A' = CROSS SECTION LINE

NOTES:
1. THIS MAP IS BASED ON SURVEY AND DRAWING MADE BY BELING ENGINEERING CONSULTANTS, JOB No. BLS19845-11 REVISED 5/10/82.
2. FOR CROSS SECTION A-A', SEE FIGURE 3. FOR CROSS SECTION B-B', SEE FIGURE 4. FOR CROSS SECTION C-C', SEE FIGURE 5.



LEGEND

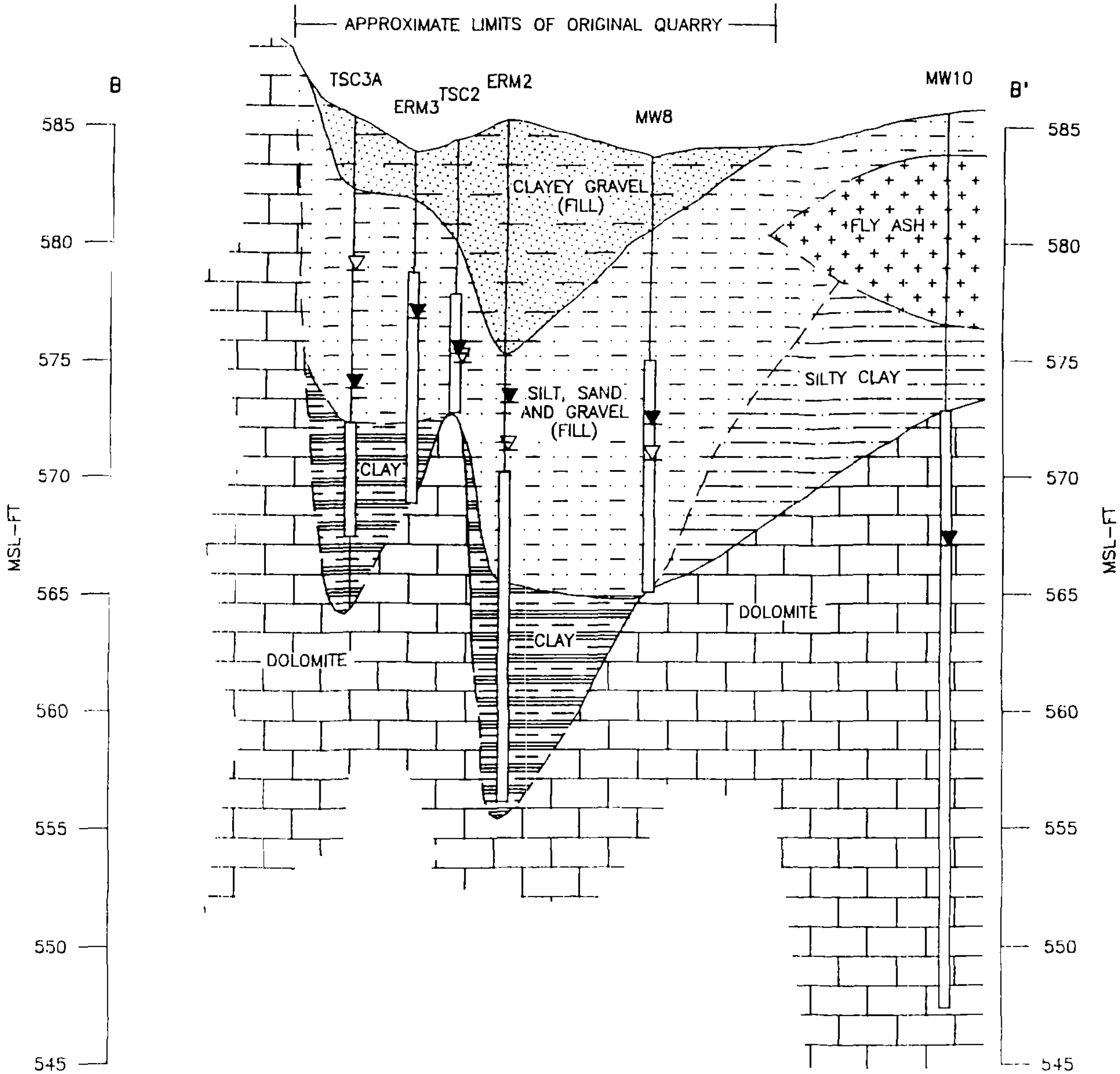
- CONTACT LINE
- INFERRED CONTACT LINE
- STATIC WATER LEVEL AT JANUARY 1990
- FIRST INDICATION OF WATER

NOTE:
FOR LOCATION OF CROSS SECTION, SEE FIGURE 2.

HORIZONTAL SCALE 1" = 80'-0"
VERTICAL SCALE 1" = 5'-0"

FIGURE 5	
GEOLOGIC CROSS SECTION A – A'	
CREST HILL, ILLINOIS PLANT FACILITY	
PREPARED FOR FLEXIBLE PRODUCTS COMPANY	
DRAWN 1/31/90 L.H.K. CHECKED APPROVED	DRAWING NUMBER 89233-B7

REMCOR



LEGEND

—— – CONTACT LINE

– – – – INFERRED CONTACT LINE

▼ – STATIC WATER LEVEL AT JANUARY 1990

▽ – FIRST INDICATION OF WATER

NOTE:
FOR LOCATION OF CROSS SECTION, SEE FIGURE 2.

HORIZONTAL SCALE 1" = 80'-0"
VERTICAL SCALE 1" = 5'-0"

FIGURE 6

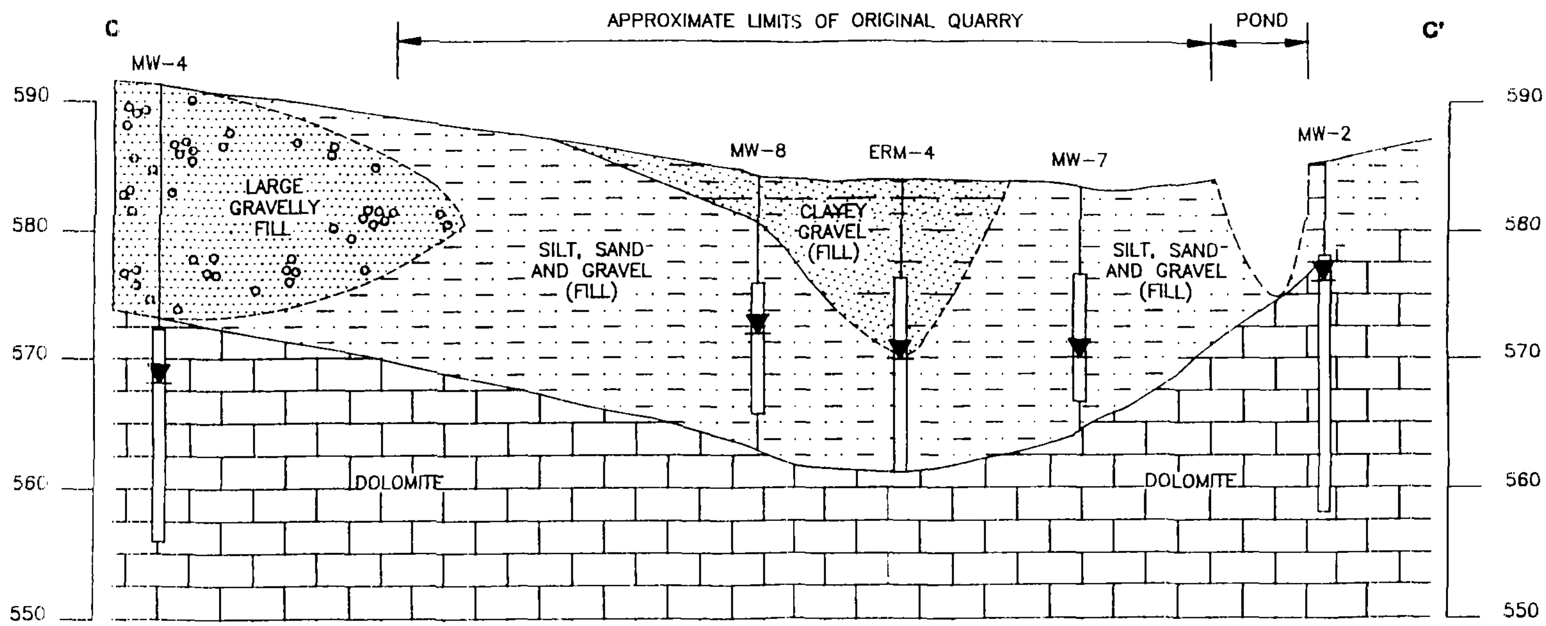
GEOLOGIC CROSS SECTION
B – B'

CREST HILL, ILLINOIS
PLANT FACILITY

PREPARED FOR
FLEXIBLE PRODUCTS COMPANY

DRAWN	2/1/90 L.H.K.	DRAWING NUMBER
CHECKED		89233–B8
APPROVED		

REMCOR



LEGEND:

- CONTACT LINE
- INFERRED CONTACT LINE
- STATIC WATER LEVEL AT JANUARY 1990

HORIZONTAL SCALE: 1" = 80'-0"
VERTICAL SCALE: 1' = 10'-0"

NOTE:
FOR LOCATION OF CROSS SECTION, SEE *FIGURE 2*.

FIGURE 7

GEOLOGIC CROSS SECTION
C - C'

CREST HILL, ILLINOIS
PLANT FACILITY

PREPARED FOR
FLEXIBLE PRODUCTS COMPANY

DRAWN	L.B.L. 2/16/90	DRAWING NUMBER
CHECKED		89233-B13
APPROVED		

REMCOR

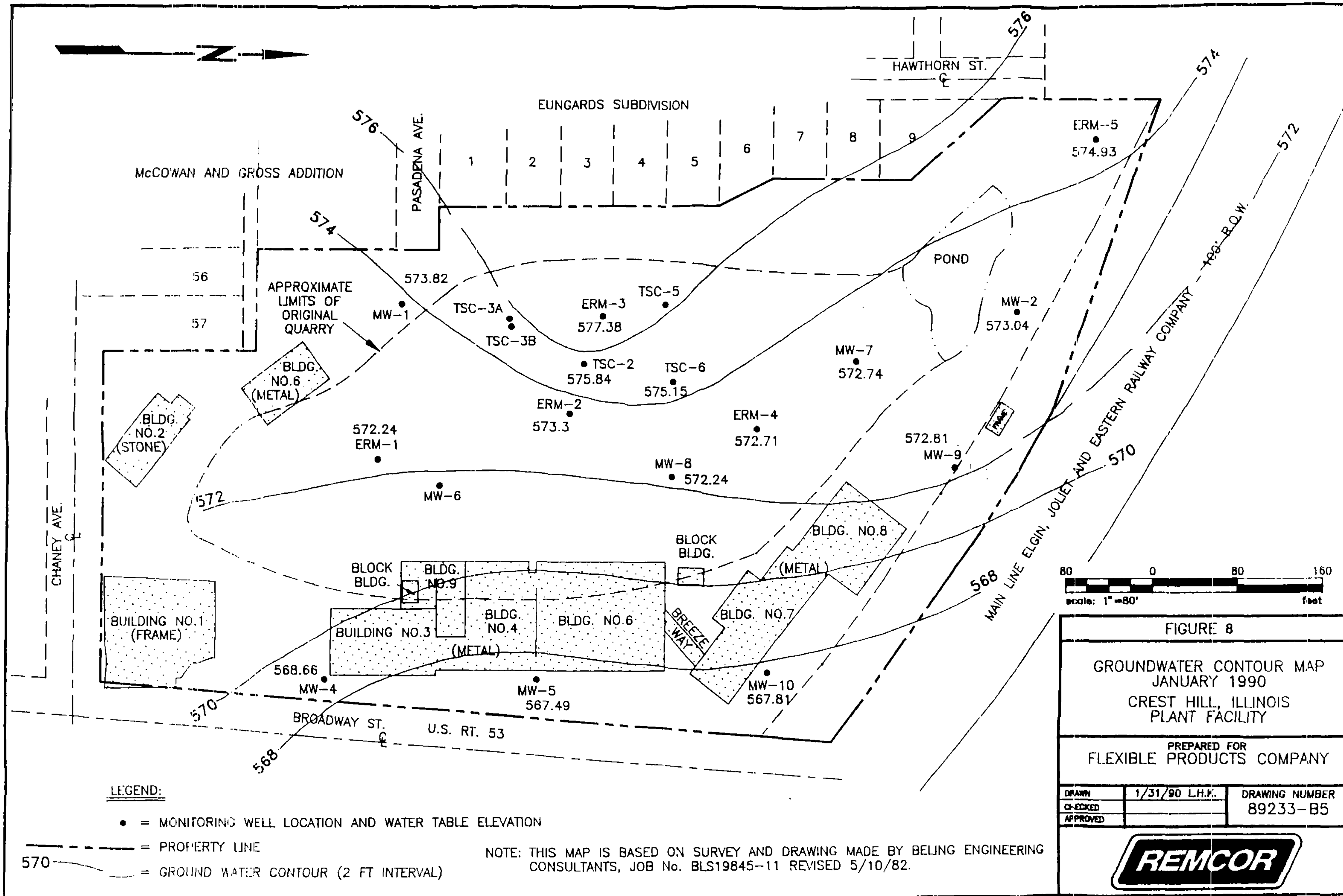
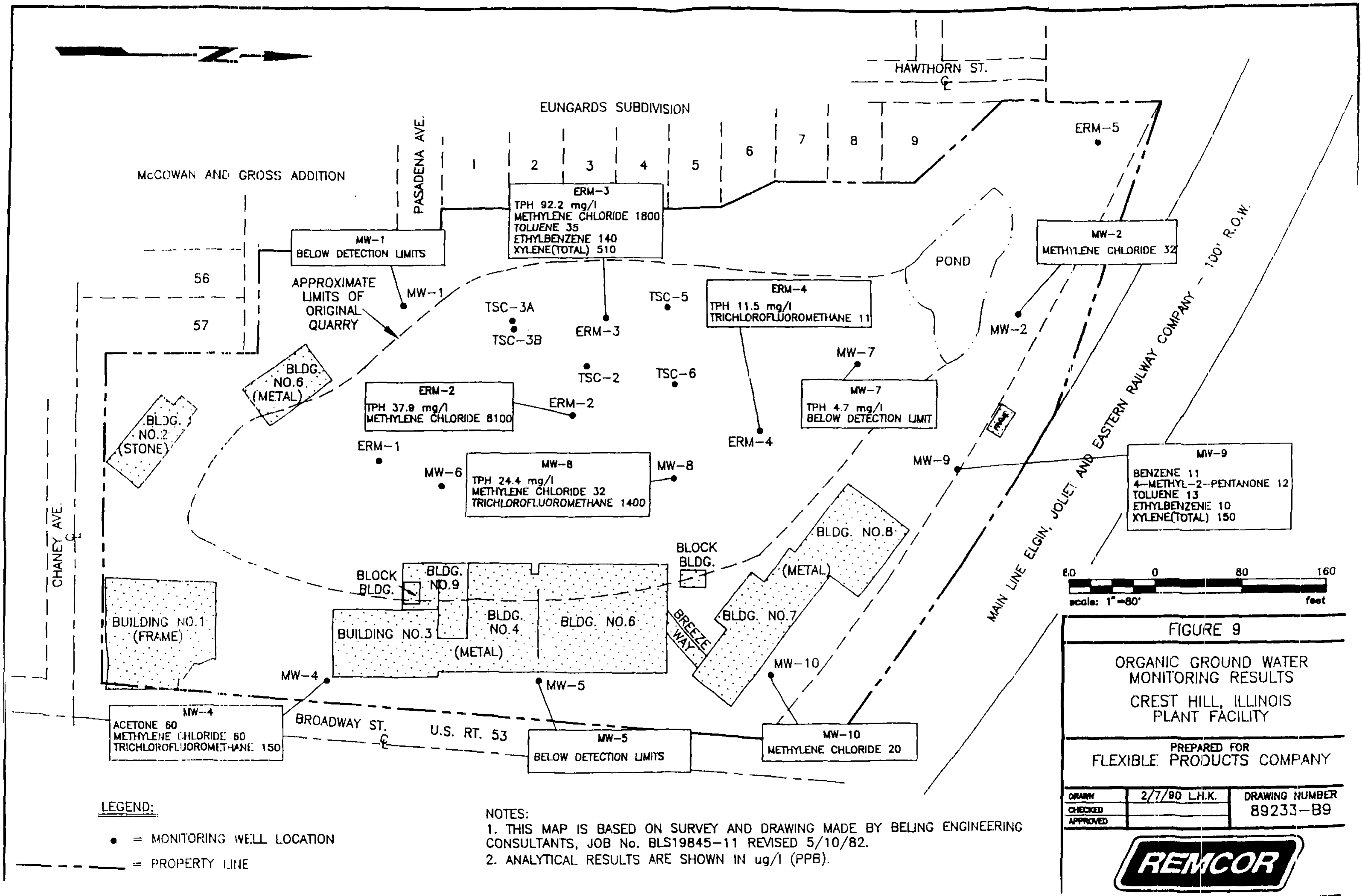
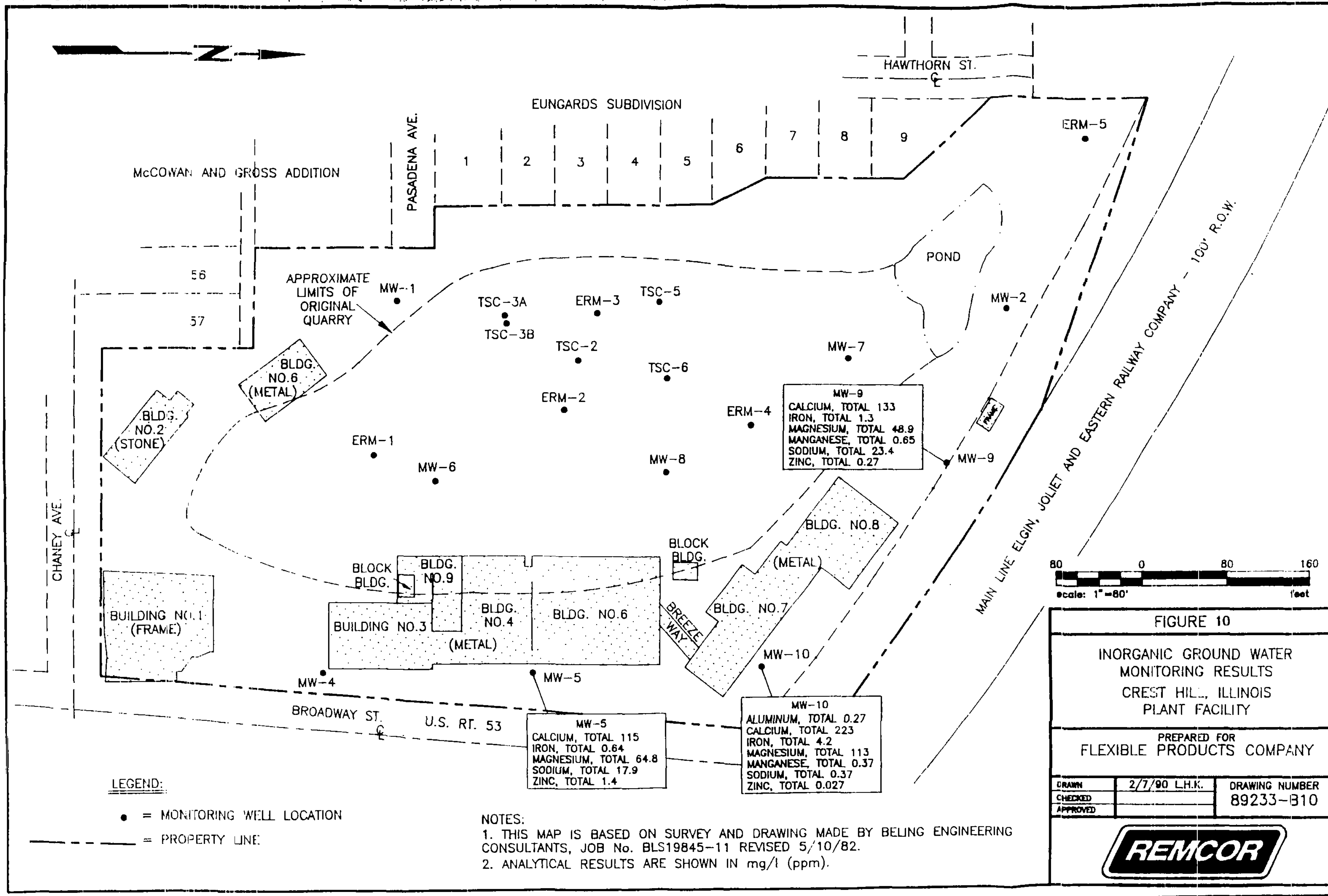


FIGURE 8

GROUNDWATER CONTOUR MAP
JANUARY 1990
CREST HILL, ILLINOIS
PLANT FACILITY


N
HAWTHORN ST.
EUNGARDS SUBDIVISION
1
2
3
4
5
6
7
8
9
McCOWAN AND GROSS ADDITION
PASADENA AVE.
ERM-5
ERM-3
TPH 92.2 mg/l
METHYLENE CHLORIDE 1800
TOLUENE 35
ETHYLBENZENE 140
XYLENE(TOTAL) 510
MW-1
BELOW DETECTION LIMITS
MW-2
METHYLENE CHLORIDE 32
POND
100' R.O.W.
56
57
APPROXIMATE LIMITS OF ORIGINAL QUARRY
MW-1
TSC-3A
TSC-3B
ERM-3
TSC-5
ERM-4
TPH 11.5 mg/l
TRICHLOROFLUOROMETHANE 11
MW-2
MW-7
TSC-2
TSC-6
MW-7
TPH 4.7 mg/l
BELOW DETECTION LIMIT
BLDG. NO.6 (METAL)
BLDG. NO.2 (STONE)
ERM-2
TPH 37.9 mg/l
METHYLENE CHLORIDE 8100
ERM-2
ERM-4
ERM-1
MW-6
MW-8
TPH 24.4 mg/l
METHYLENE CHLORIDE 32
TRICHLOROFLUOROMETHANE 1400
MW-8
MW-9
MW-9
BENZENE 11
4-METHYL-2-PENTANONE 12
TOLUENE 13
ETHYLBENZENE 10
XYLENE(TOTAL) 150
ELGIN, JOLIET AND EASTERN RAILWAY COMPANY
MAIN LINE ELGIN, JOLIET AND EASTERN RAILWAY COMPANY
CHANEY AVE.
BLOCK BLDG.
BLDG. NO.9
BLOCK BLDG.
BLDG. NO.8 (METAL)
BUILDING NO.1 (FRAME)
BUILDING NO.3
BLDG. NO.4
(METAL)
BLDG. NO.6
BREEZE WAY
BLDG. NO.7
MW-10
MW-4
MW-5
MW-4
ACETONE 60
METHYLENE CHLORIDE 60
TRICHLOROFLUOROMETHANE 150
BROADWAY ST.
U.S. RT. 53
MW-5
BELOW DETECTION LIMITS
MW-10
METHYLENE CHLORIDE 20
80 0 80 160
scale: 1"=80'
feet
FIGURE 9
ORGANIC GROUND WATER MONITORING RESULTS
CREST HILL, ILLINOIS PLANT FACILITY
PREPARED FOR FLEXIBLE PRODUCTS COMPANY
DRAWN 2/7/90 L.H.K.
CHECKED
APPROVED
DRAWING NUMBER 89233-B9
REMCOR
LEGEND:
• = MONITORING WELL LOCATION
= PROPERTY LINE
NOTES:
1. THIS MAP IS BASED ON SURVEY AND DRAWING MADE BY BELING ENGINEERING CONSULTANTS, JOB No. BLS19845-11 REVISED 5/10/82.
2. ANALYTICAL RESULTS ARE SHOWN IN ug/l (PPB).


N
HAWTHORN ST.
EUNGARDS SUBDIVISION
PASADENA AVE.
1
2
3
4
5
6
7
8
9
McCOWAN AND GROSS ADDITION
56
57
ERM-5
POND
APPROXIMATE LIMITS OF ORIGINAL QUARRY
MW-1
TSC-3A
TSC-3B
ERM-3
TSC-5
MW-2
TSC-2
MW-7
TSC-6
BLDG. NO.6 (METAL)
BLDG. NO.2 (STONE)
ERM-2
ERM-4
ERM-1
MW-6
MW-8
MW-9
MW-9
CALCIUM, TOTAL 133
IRON, TOTAL 1.3
MAGNESIUM, TOTAL 48.9
MANGANESE, TOTAL 0.65
SODIUM, TOTAL 23.4
ZINC, TOTAL 0.27
CHANEY AVE.
BLDG. NO.8
(METAL)
BLOCK BLDG.
BLOCK BLDG.
BLDG. NO.9
BLDG. NO.4
BLDG. NO.6
BUILDING NO.1 (FRAME)
BUILDING NO.3
(METAL)
BREEZE WAY
BLDG. NO.7
MW-10
MW-4
MW-5
BROADWAY ST.
U.S. RT. 53
MAIN LINE ELGIN, JOLIET AND EASTERN RAILWAY COMPANY - 100' R.O.W.
MW-5
CALCIUM, TOTAL 115
IRON, TOTAL 0.64
MAGNESIUM, TOTAL 64.8
SODIUM, TOTAL 17.9
ZINC, TOTAL 1.4
MW-10
ALUMINUM, TOTAL 0.27
CALCIUM, TOTAL 223
IRON, TOTAL 4.2
MAGNESIUM, TOTAL 113
MANGANESE, TOTAL 0.37
SODIUM, TOTAL 0.37
ZINC, TOTAL 0.027
80 0 80 160
scale: 1"=80' feet
LEGEND:
● = MONITORING WELL LOCATION
= PROPERTY LINE
NOTES:
1. THIS MAP IS BASED ON SURVEY AND DRAWING MADE BY BELING ENGINEERING CONSULTANTS, JOB No. BLS19845-11 REVISED 5/10/82.
2. ANALYTICAL RESULTS ARE SHOWN IN mg/l (ppm).
FIGURE 10
INORGANIC GROUND WATER MONITORING RESULTS
CREST HILL, ILLINOIS PLANT FACILITY
PREPARED FOR
FLEXIBLE PRODUCTS COMPANY
DRAWN 2/7/90 L.H.K.
CHECKED
APPROVED
DRAWING NUMBER
89233-B10
REMCOR

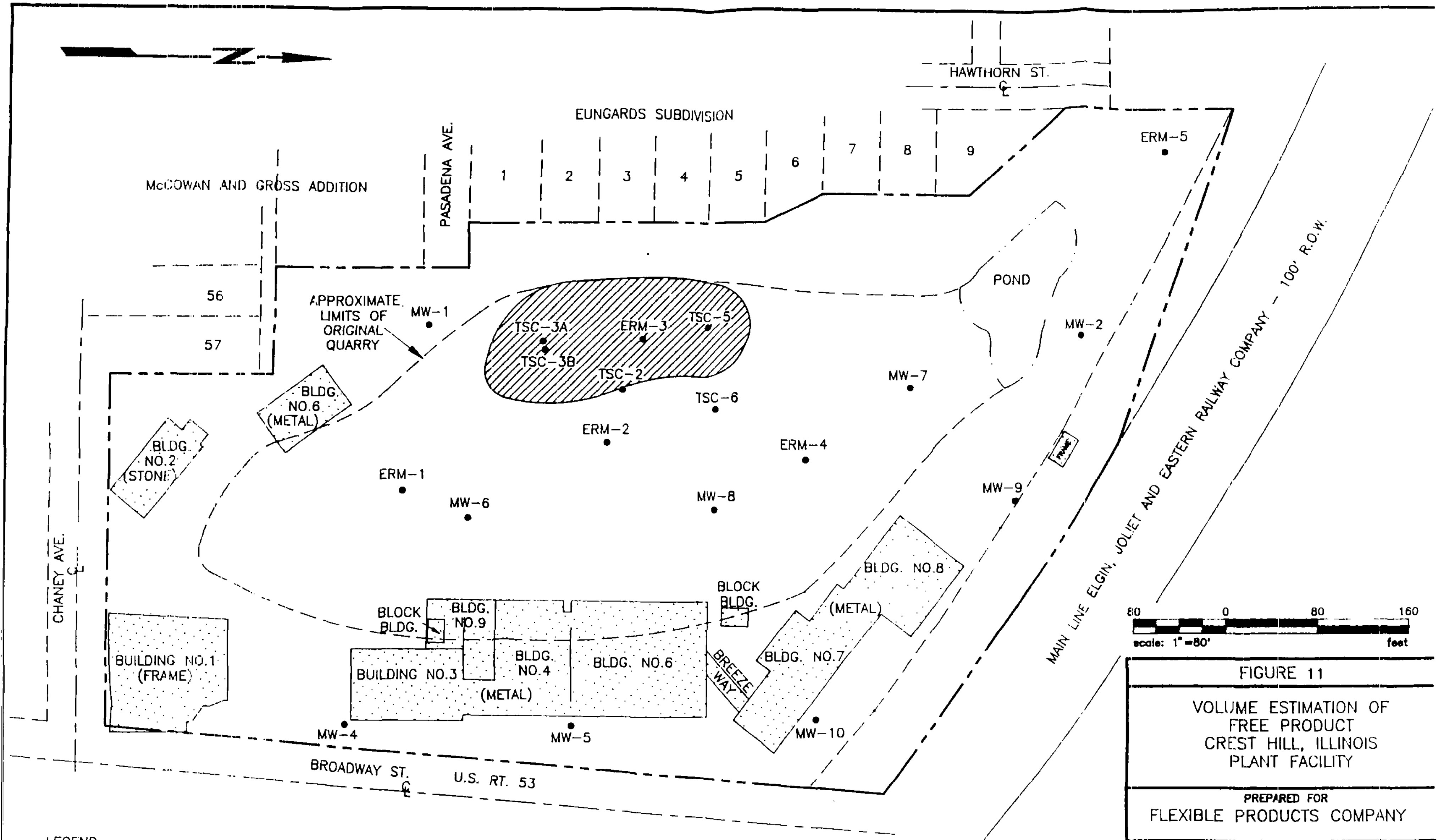


FIGURE 11

VOLUME ESTIMATION OF FREE PRODUCT
CREST HILL, ILLINOIS
PLANT FACILITY

PREPARED FOR
FLEXIBLE PRODUCTS COMPANY

DRAWN	L.B.L. 3/5/90	DRAWING NUMBER
CHECKED		89233-B16
APPROVED		

REMCOR

LEGEND:

• = MONITORING WELL LOCATION

— — = PROPERTY LINE

= ESTIMATED FREE PRODUCT PLUME (AREA: 19,517.3 FT²)

NOTE: THIS MAP IS BASED ON SURVEY AND DRAWING MADE BY BELING ENGINEERING CONSULTANTS, JOB No. BLS19845-11 REVISED 5/10/82.

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